August 2023

Augmented Reality Glasses that Accommodate a Wide Range of Ophthalmic Prescriptions

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ABSTRACT

Traditional eyewear frames are designed to accommodate a wide range of prescriptions. This includes the ability to include strong corrective lenses of significant thickness. However, augmented reality (AR) glasses with integrated displays can be much more constrained in terms of thickness, weight, and mechanical features since they have to accommodate a much larger number of components. As a result, traditional eyewear lens installation methods and features may not be feasible in AR glasses. This disclosure describes an ophthalmic lens edge profile and frame construction that minimizes mass and volume. The lens edge combined with the frame construction that includes an outer frame, an inner frame, and a step bevel, allows for a slim and compact solution that can accommodate prescription lenses.

KEYWORDS

- Augmented reality
- AR glasses
- AR eyewear
- AR headset
- Prescription lens
- Ophthalmic prescription
- Split eyeglass frame
- Step bevel

BACKGROUND

Traditional eyewear frames are designed to accommodate a wide range of prescriptions. This includes the ability to include strong corrective lenses of significant thickness. However, augmented reality (AR) glasses with integrated displays can be much more constrained in terms of thickness, weight, and mechanical features since they have to accommodate a much larger number of components, e.g., a display, a camera, and multiple sensors. As a result, traditional eyewear lens installation methods and features may not be feasible in AR glasses. New methods and features are needed if AR glasses are to have a similar overall package. Additionally, with mass manufactured AR glasses, it is imperative that unique prescription lenses can be integrated into the design without impacting other components.

DESCRIPTION

This disclosure describes an ophthalmic lens edge profile and frame construction that minimizes mass and volume, and the perceived appearance thereof. The lens edge combined with the frame construction allows for a slim and compact solution that can also accommodate prescription lenses.

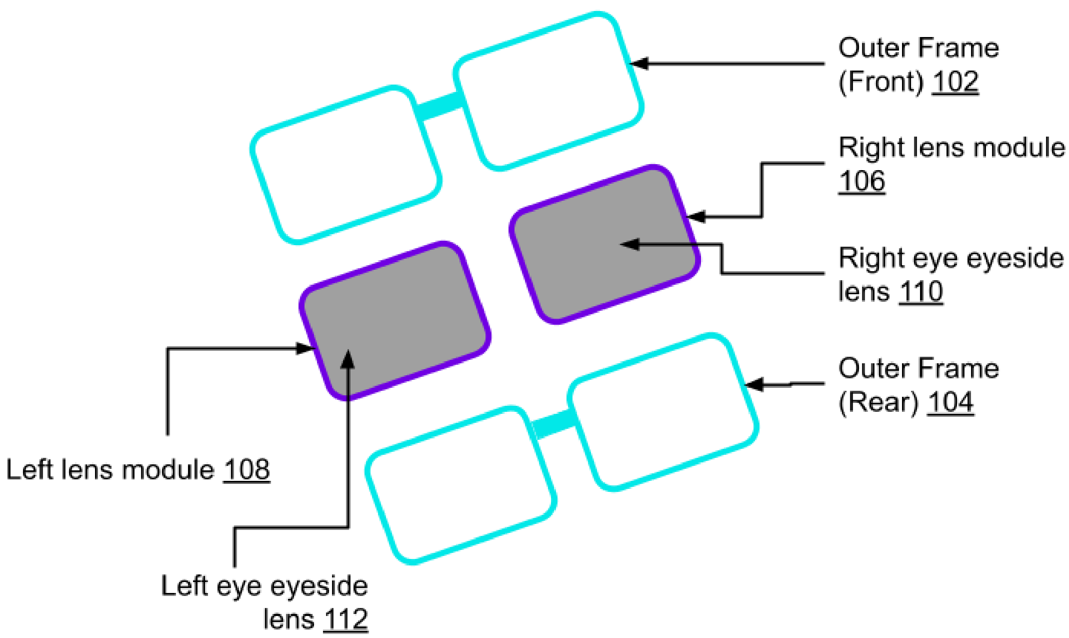

Fig. 1: Accommodating a wide range of ophthalmic prescriptions in AR glasses (exploded view)

Fig. 1 illustrates an exploded view for accommodating a wide range of ophthalmic prescriptions in AR glasses. The AR glasses have a conventional frame that includes an outer frame on the front (102) and the rear component of the outer frame (104). The AR glasses frame design is thus split into two components - the front frame and rear frame. The lens module installs into the front frame, and the rear frame installs afterwards and interfaces with the static lens shelf surface. The rear frame has a large opening clearing space for the prescription surface of the lens to protrude through.

The thickness of the front frame, the lens module, and the rear frame dictate the overall frame thickness, such that the lens step bevel thickness is the dominating dimension determining the overall thickness. The lens shelf bevel can be as small as less than 0.6mm thick. The combination of lens edge step bevel and the frame construction enables a unique solution for thin, lightweight mass producible AR glasses that can also incorporate a wide range of vision correction. Within the outer frame lies the lens module, divided into two parts, the right lens module (106) and the left lens module (108). Each lens module has a lens within it - the right eye eyeside lens (110) and the left eye eyeside lens (112).

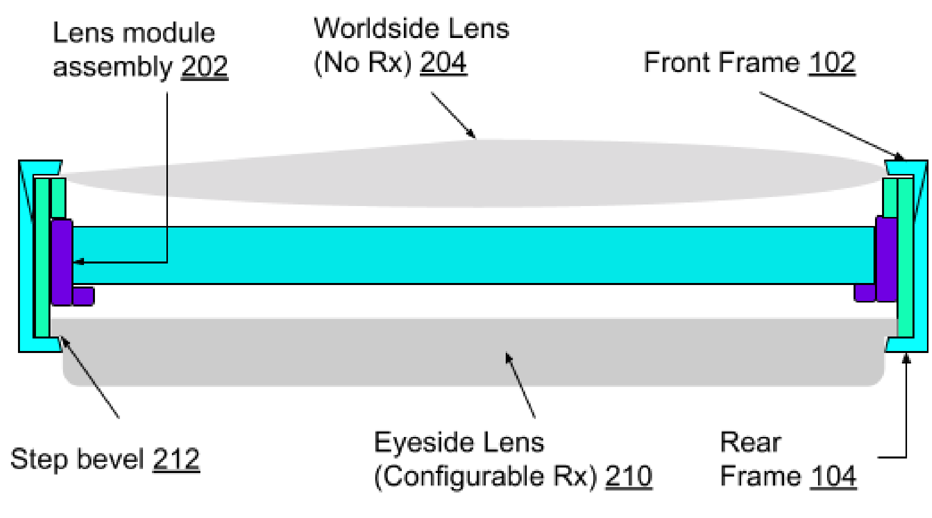

Fig. 2: Cross-section view of method to accommodate a wide range of ophthalmic prescriptions in AR glasses

Fig. 2 shows how an ophthalmic lens edge profile and frame construction is utilized that minimizes mass and volume. The lens edge combined with the frame construction allows for a slim and compact solution that can also accommodate prescription lenses. The lens module assembly (202) includes a worldside lens which is not prescription-based (204). It also includes an eyeside lens which can be prescription-based (210). This prescription-based lens can be as thick as necessitated by the prescription. The lenses are encased within the front frame (102) and the rear frame (104) of the AR glasses.

The AR glasses use a step bevel (212) for the lens edge cut that creates a thin shelf around the perimeter of the back surface. This lens shelf surface remains the same, independent of the prescription and thus the lens can be easily incorporated into the AR glasses design using mass manufactured parts. The surface that changes due to prescription is within the border of this shelf and projects into the open volume between the AR glasses and the user’s eye.

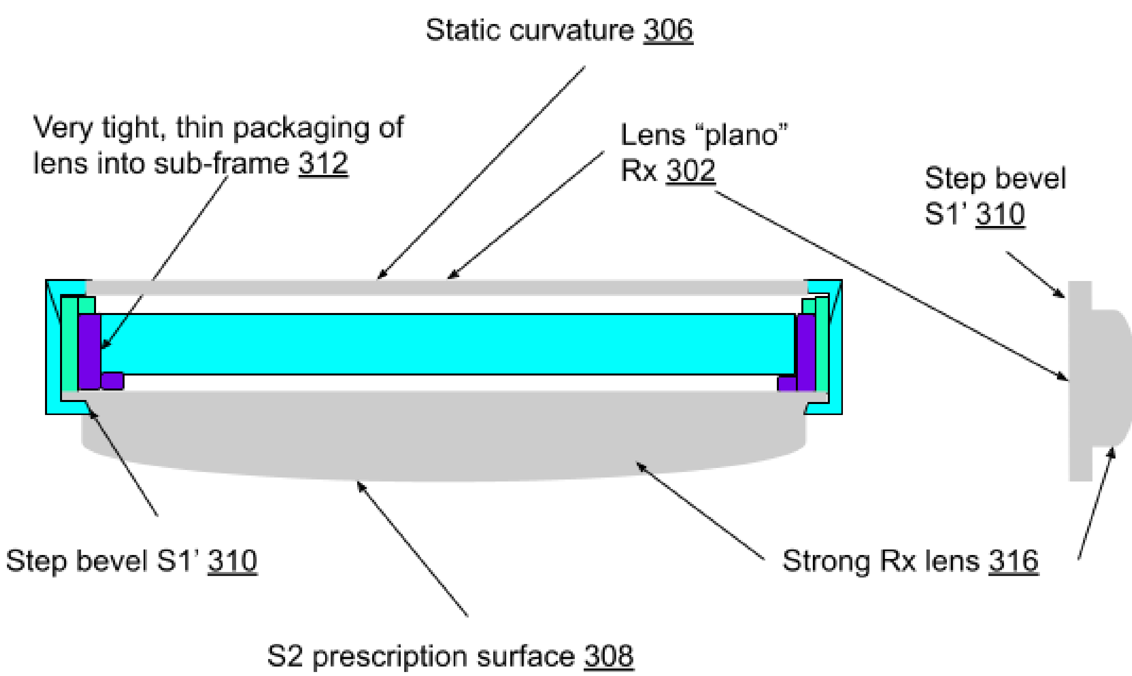

Fig. 3: Accommodating a wide range of ophthalmic prescriptions in AR glasses (lens detail)

Fig. 3 shows how a plano lens (302) can be mounted within the AR glasses. Plano lenses are non-prescription based lenses that do not provide any magnification. Such a lens (302) can be attached to AR glasses in the manner shown in Fig. 3. The lens module installs into the front frame, and the rear frame installs afterwards and interfaces with the static lens shelf surface. This lens surface has two sides, with the side on the outside being S1 or the static curvature (306) while the prescription surface S2 is on the inside (308). Lying between these two is the step bevel S1’ (310) which is static with respect to S1.

The advantage of the bevel is that even a strong prescription lens (with substantial thickness) can be fitted into such an assembly. This is made possible because of the very tight, thin packaging of the lens into the sub-frame (312). Due to the bevel, the rear frame overlap never changes, no matter the size of the prescription lenses. As a result, even a very strong (e.g., 7D strong Rx or of any other strength) lens (316) can be used.

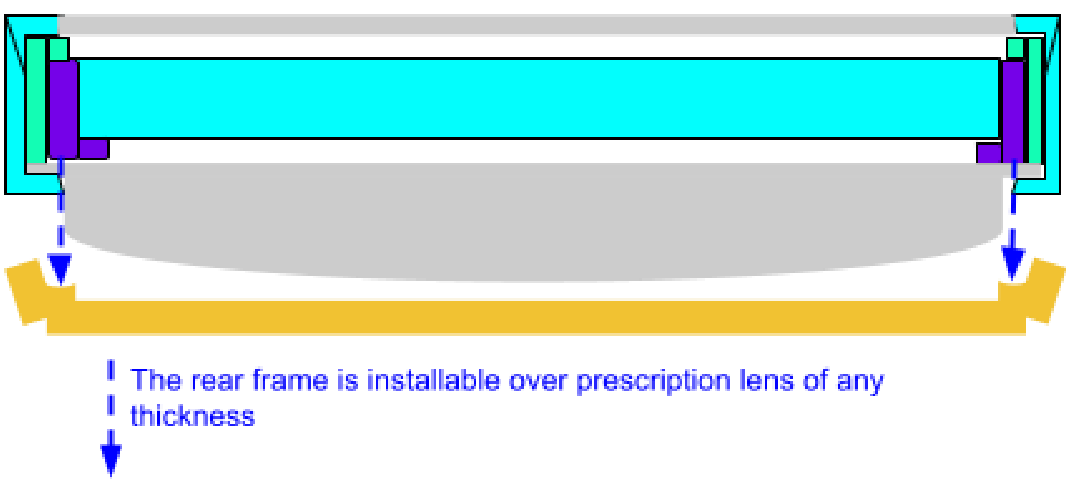

Fig. 4: Rear frame installation over Rx Lens

Fig. 4 shows rear frame installation over a thick prescription lens. The rear frame has a large opening clearing space for the prescription surface of the lens to protrude through. The thickness of the front frame, lens module and rear frame dictate the overall frame thickness, such that the lens step bevel thickness is the dominating dimension determining the overall thickness. The lens shelf bevel can be optimized to be thin (e.g., less than 0.6mm thick). The combination of a lens edge step bevel and the frame construction enables thin, lightweight mass producible AR glasses that can incorporate a wide range of vision correction.

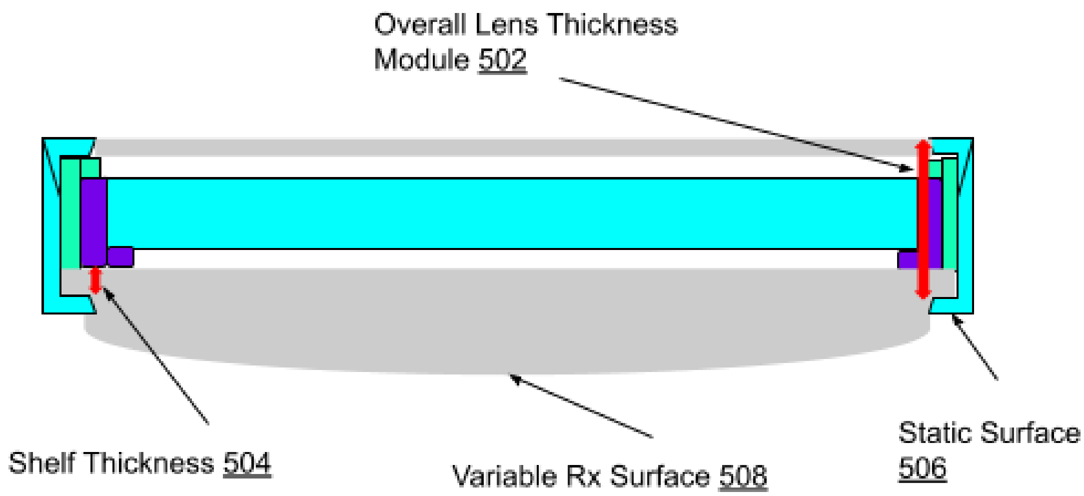

Fig. 5: Optimal packaging for stack thickness

Fig. 5 illustrates that the described assembly can achieve optimal packaging for stack thickness. The described assembly allows for a larger overall lens module thickness (502), which is made possible by the shelf thickness (504). The shelf thickness lies just above the status surface (506) which is where the (variable) Rx surface is located (508). This Rx surface is the lens shown in Fig. 5.

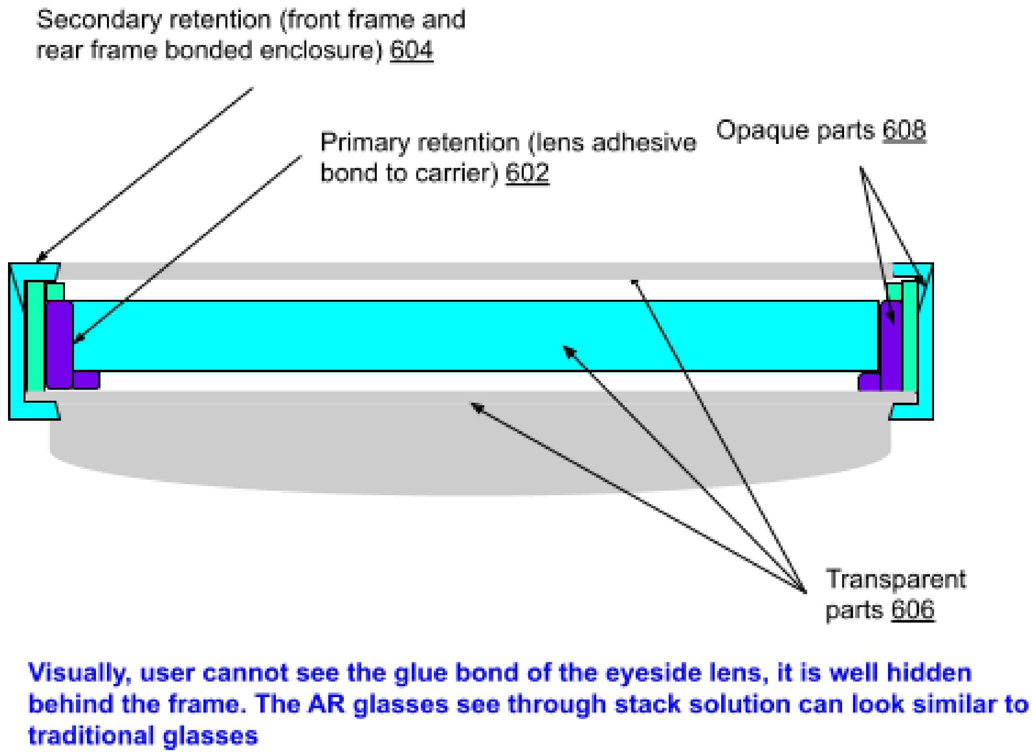

Fig. 6: Cross-section - redundant retention and visual quality

Fig. 6 illustrates how visual quality remains unaffected by the assembly. Visually, the user cannot see the glue bond of the eyeside lens, since it is well hidden behind the frame. The entire assembly is affixed in place through two different retention methods. The first is the primary retention (602), which is the lens adhesive bond to the carrier. There is also a redundant, secondary retention (604) where the front and the rear frame form a bonded enclosure. Since the transparent parts of the assembly (606) are affixed to the opaque parts (608), the AR glasses see-through stack solution can look similar to traditional glasses.

The step bevel allows for the sealing and bonding surface of the lens to be hidden from user view by the front and rear frames, creating a seamless appearance of the lenses as a user would expect in eyewear. Another advantage is the redundant lens mechanical retention which supports the lens from de-bonding during frame flex and other external loading. The step bevel bond to the carrier, as well as the front and rear frame bond work in concert to retain the lenses.

CONCLUSION

This disclosure describes an ophthalmic lens edge profile and frame construction that minimizes mass and volume. The lens edge combined with the frame construction that includes an outer frame, an inner frame, and a step bevel, allows for a slim and compact solution that can accommodate prescription lenses.

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